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**XXV. Numerical Elements of Indian Meteorology. By HERMANN DE SCHLAGINTWEIT,  
Ph.D., LL.D., Corr. Memb. Acad. Munich, Madrid, Lisbon, &c. Communicated by  
MAJOR-GENERAL SABINE, P.R.S.**

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**FIRST SERIES.—Temperatures of the Atmosphere, and Isothermal Lines of India.**

- I. Materials collected: calculation of the Daily Mean.
- II. Tables of 207 Stations of Mean Temperature—Months, Seasons, and Years.
- III. Decrease of Temperature with Height in the Tropics.
- IV. Thermal Types of the Year and the Seasons.

**I. Materials collected: calculation of the Daily Mean.**

THE numerical elements of the mean temperature\* of the atmosphere for India and the Indian Archipelago here presented, I had occasion to collect during the years 1854–58. For judging of the value of the data I had obtained, and for working out the general results, it was very favourable that, for most of the stations, I had occasion personally to see the instruments employed and the mode of their being put up.

Already some years ago a considerable number of these stations had been published for the year 1851, by Dr. LAMBE in the Journal of the Asiatic Society of Bengal, as well as by Colonel SYKES in the Report of the British Association for 1852; but as the materials sent in consisted, nearly exclusively, of results presented as means, which however were but the plain arithmetical mean of the respective hours of observation without any further modification, it was particularly welcome to me that the Indian Government, by the mediation of Dr. MACPHERSON, handed me over the original manuscripts, now forming thirty-nine volumes in folio.

A new calculation of the mean temperatures showed for many of these stations, particularly for the warmer period of the year, results lower by many degrees than the values formerly adopted; the difference would have been greater still and more frequent, if for many of the Indian stations the daily variation of temperature had not been included altogether within comparatively narrow limits.

The publication of Colonel SYKES† in 1850, the observations communicated being his own, or those of contemporaneous residents, contains throughout means based upon hours carefully selected.

\* All temperatures are Fahrenheit.

† “Discussion of Meteorological Observations taken in India,” by Colonel W. H. SYKES, F.R.S., Philosophical Transactions, Part II. 1850.

Also the meteorological publications of DOVE and SCHMIDT\* contained important contributions for completing the number of the Indian stations, and for comparing them with the surrounding regions†.

The hours of observation at the various stations had been in general selected so as to include the minimum at the time of sunrise and the hours 10 A.M., 4 P.M., these two nearly coinciding with the barometrical extremes; also the maximum of the day a little after 2 P.M., and an evening observation is very frequently contained in these Tables; but, with few exceptions, the latest period was 6 P.M., or sunset. This circumstance excluded therefore the introduction of an evening hour more distant from the maximum, such as 9 P.M. or 10 P.M., into the calculation of the mean. A very favourable modification it was, however, that hourly observations existed for several stations, very accurately made, though situated in regions where the daily variation of temperature is not a very great one. These stations are Bombay, Calcutta, Madras, Trevandrum. Already DOVE, so very careful in completing his collections of meteorological materials, has published several years for each of these stations‡. For calculating such Indian stations as show a more continental character in their variation of temperature, I could take advantage of the observations which we had occasion to make ourselves during our travels, a material which, I think, presented sufficient data for defining the mode of calculation, by their number as well as by their geographical distribution.

A combination of sunrise and sunset with either the maximum of the day or the observation at 4 P.M. showed very unfavourable results, even if variable coefficients were introduced for the different months, since, for the various geographical regions, the changes in the daily variation of temperature during the year are very great. Also the combination of the extremes with one morning hour, as I formerly had applied them to Alpine stations§, gave no satisfactory results, since in India the morning hours 9 A.M. or 10 A.M. had risen already considerably more above the mean of the day than is the case in the temperate zone.

\* DOVE, "Tafel der mittleren Temperaturen verschiedener Orte in Réaumur'schen Graden," and "Ueber die nicht periodischen Änderungen der Temperaturvertheilung," 6 parts.

† Amongst the 207 stations of the numerical Tables, pages 532-537, the following stations had to be taken over without recalculation, or without the addition of new material: from the publications of Colonel SYKES, Átare Mällé, Ahmednágar, Mahabaléshvar, Máhu, Pháltán, Púna, Satára; from the series of the Medical Board Observations only Gughéra remained without the addition of new material; and from DOVE's Tables I took over, with their values unchanged, Álor Gája, Áva, Bangkók, Chandernagúr, Chúsan, Kálsi, Kándi, Kántón, Makáo, Manilla, Mozáfarpúr, Pondichéri, Trivándrum. DOVE's Seringapatám is the year 1816 for the neighbouring fort, French Rocks, for which I was able to add 1814, 1853, and 1854. In the "Lehrbuch der Meteorologie," von SCHMIDT, 1860, I found in addition, for the Archipelago, Banjuvángi, Palanbáng, Lahút. For want of details about the decrease of temperature with height in these regions I excluded them, their height being 2138, 2119, and 2104 feet.

‡ On the Daily Variations of the Temperature of the Atmosphere, Abhandl. Berl. Akad. for 1846, pp. 104-6.

§ SCHLAGINTWEIT, "Neue Unters. phys. Geogr. d. Alpen," page 325; I had obtained there the following coefficients for deducing the mean temperature from the extremes and 9 A.M.: for the minimum 0.5; for the maximum 0.4; for 9 A.M. 0.11.

The arithmetical mean of the extremes, where registering-instruments had been used, showed temperatures in general too warm throughout the year; but this very circumstance induced me to try the combination of 4 P.M. (which I had for all stations) with the observations at sunrise; the latter is nearly always identical (except at stations in very great heights) with the minimum obtained by registering-instruments, and four o'clock is cooler, though but little, than the true maximum; the result was a much more satisfactory one than I had expected.

The coincidence of the minimum of temperature with sunrise is particularly general in the tropics. It materially depends upon the rapid ascent of the sun above the horizon, whilst with us, especially in summer, the effect of *insolation* upon clouds and the higher strata of the atmosphere is partly felt already on the surface of the earth before the sun himself is visible above the horizon. In very great heights, again, chiefly if it be a peak in a very isolated position, the tropics show also modifications similar to those of the temperate zones. There I found, just as I formerly had seen, too, on the Vincent Hütte (southern slope of Monte Rosa), that the temperature frequently began to rise several hours before sunrise\*.

As another characteristic modification of the morning period in the tropics, I may add here that very frequently the absolute minimum is followed by a second, though minor depression. This becomes best marked in the tropical seas; I found it greatest, when the sky was clear, five to ten minutes after sunrise, and it amounted not unfrequently to a full degree, but it never went lower than the absolute minimum preceding. I considered the cause of it to be the change in the relative humidity, which has attained its maximum nearly at the moment of sunrise. The appearance of the sun above the horizon coincides, too, with the heaviest precipitation of dew, and from this moment the relative humidity is rapidly decreasing whilst the temperature begins to rise. Not only is radiation now increased with the transparency of the atmosphere, but also the amount of heat becoming latent in consequence of the dissolving of vesicular vapours might participate in producing the second depression of temperature.

For presenting an immediate comparison of the value  $\frac{\text{min.} + 4 \text{ P.M.}}{2}$  with the mean of the 24 hours, I have given the corrections to be applied in the following Tables (with “—” if the calculated value is too large, with “+” if it is too small), and have added the corresponding corrections for three other combinations. At Bombay and Calcutta, hourly observations are made every day, Sundays excepted; I took 1855 as the year the least distant from any other observations. For Tónglo, Falút, Islamabád, and Leh, the periods of observation are only months. For Ambálá I had no quite regular series completely including the daily period, but the considerable number of observations from morning to night, combined (by the particular kindness of the observer, Dr. TRITTON) with very good extremes and isolated nocturnal observations, allowed me to define with sufficient precision the form of the monthly curves, and to deduce from these the hours still wanted.

\* Neue Unters. Geogr. Alpen, pp. 278–80.

I thought it not uninteresting to complete the comparison of my mode of calculating with those generally used, by adding the value of  $\frac{\text{min.} + 4 \text{ A.M.}}{2}$  also for some other stations, situated beyond India, and greatly differing in reference to their climatological character.

*A. From India, the Himalaya, and Tibet.*

Bombay in the Kónkan, lat. N.  $18^{\circ} 53' 30''$ , long. E. Green.  $72^{\circ} 49' 5''$ , height L.a.L.S.\*

1855.	Mean.	<u>S. R.+IV.</u> 2	<u>Max.+Min.</u> 2	<u>VI.+II.+X.</u> 3	<u>VII.+II.+2.IX.</u> 4
January .....	74.7	-0.6	-0.9	+0.1	0
February .....	76.9	-0.5	-0.8	+0.1	0
March .....	79.3	0	-0.5	+0.5	+0.4
April .....	82.0	+0.3	-0.4	+0.6	+0.3
May .....	86.0	-0.3	-0.7	+0.4	+0.2
June .....	83.8	+0.1	-0.5	+0.2	+0.3
July .....	82.0	+0.1	-0.7	+0.1	+0.3
August .....	82.1	-0.5	-0.7	+0.4	+0.1
September .....	81.0	-0.2	-0.7	+0.1	+0.3
October .....	82.6	0	-0.7	+0.2	0
November .....	80.6	-0.7	-1.2	-0.1	-0.1
December .....	77.7	-0.7	-1.2	+0.1	-0.1
Mean ...	.....	-0.12	-0.38	+0.11	+0.08

Calcutta in Bengal, lat. N.  $22^{\circ} 33' 1''$ , long. E. Green.  $88^{\circ} 20' 34''$ , height L.a.L.S.

1855.	Mean.	<u>S. R.+IV.</u> 2	<u>Max.+Min.</u> 2	<u>VI.+II.+X.</u> 3	<u>VII.+II.+2.IX.</u> 4
January .....	66.5	0	-0.9	0	0
February .....	72.1	-0.8	-1.1	-0.3	-0.3
March .....	79.3	-0.6	-0.8	+0.4	+0.5
April .....	82.3	0	-0.3	+1.1	+1.3
May .....	85.9	-0.6	-1.1	+0.3	+0.7
June .....	85.6	+0.1	-0.6	+0.4	+0.3
July .....	82.3	+0.4	-0.5	+0.1	0
August .....	83.7	+0.2	-0.5	+0.3	+0.3
September .....	82.3	+0.3	-0.6	0	+0.1
October .....	81.2	+0.2	-0.4	+0.3	+0.2
November .....	74.4	+0.2	-0.9	0	+0.3
December ...	66.9	+0.1	-1.2	0	0
Mean ...	.....	-0.02	-0.73	+0.11	+0.14

Ambála in the Pánjab, lat. N.  $30^{\circ} 21' 25''$ , long. E. Green.  $76^{\circ} 48' 49''$ , height 1026 feet.

1855.	Mean.	<u>S. R.+IV.</u> 2	<u>Max.+Min.</u> 2	<u>VI.+II.+X.</u> 3	<u>VII.+II.+2.IX.</u> 4
January .....	50.1	-0.1	-0.6	+0.5	+0.5
February .....	59.5	-0.1	-0.7	+1.3	+1.0
March .....	56.5	-0.2	-0.3	+1.4	+0.4
April .....	76.0	+0.7	+0.2	+2.3	+0.2
May .....	92.1	+1.7	+1.1	+0.5	-1.1
June .....	95.4	+1.2	+0.9	+0.2	-1.0
July .....	83.8	+0.3	+0.2	+0.1	+1.3
August .....	87.9	+1.1	+0.5	-0.6	+2.0
September .....	82.4	+1.1	+0.9	+1.1	+0.4
October .....	73.4	+0.3	+0.1	+1.8	+0.7
November .....	60.2	-1.9	-2.2	-0.7	-1.7
December ...	55.9	+0.8	-0.2	-0.9	+0.8
Mean .....	.....	+0.41	-0.01	+0.58	+0.22

\* This abbreviation is placed for "a little above the level of the sea." The feet are English.

Tónglo Peak in Síkkim, lat. N.  $27^{\circ} 1' 50''$ , long. E. Green.  $28^{\circ} 3' 55''$ , height 10,080 feet.

1855.	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
May .....	48.1	+0.5	-1.5	-0.2	0

Falút Peak in Síkkim, lat. N.  $27^{\circ} 6' 20''$ , long. E. Green.  $87^{\circ} 59' 0''$ , height 12,042 feet.

1855.	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
May .....	46.9	-0.1	-0.5	0	0

Islamabád in Kashmír, lat. N.  $33^{\circ} 44'$ , long. E. Green.  $75^{\circ} 8'$ , height 5160 feet.

1856.	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
October .....	51.3	+0.7	+0.3	+1.3	-0.7

Leh in Ladák, lat. N.  $24^{\circ} 8' 2''$ , long. E. Green.  $77^{\circ} 14' 36''$ , height 11,527 feet.

1856.	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
September ...	60.1	-0.1	-0.2	+0.7	-0.2

B.\* *From the temperate zone in low elevations.*

Rome, lat. N.  $41^{\circ} 54'$ , long. E. Green.  $12^{\circ} 25'$ , height 170 feet.

	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
January .....	49.95	-0.07	-1.15	-0.22	+0.09
July .....	75.47	+0.36	+0.20	+1.62	+0.97

Greenwich, lat. N.  $51^{\circ} 29'$ , long. E. Green.  $0^{\circ} 0'$ , height 156 feet.

	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
January .....	35.45	-0.02	-0.40	-0.31	-0.22
July .....	59.65	+0.40	-0.34	+0.45	-0.13

St. Petersburgh, lat. N.  $59^{\circ} 36'$ , long. E. Green.  $30^{\circ} 18'$ , height L.a.L.S.

	Mean.	$\frac{S.R.+IV.}{2}$	$\frac{Max.+Min.}{2}$	$\frac{VI.+II.+X.}{3}$	$\frac{VII.+II.+2.IX.}{4}$
January .....	13.57	+0.16	-0.11	-0.29	-0.25
July .....	62.37	-0.12	-0.13	+0.47	-0.11

\* The date is not added, the means being taken from various series, all of several years' duration.

Toronto, lat. N.  $43^{\circ} 40'$ , long. W. Green.  $79^{\circ} 22'$ , height 340 feet.

	Mean.	$\frac{S. R. + IV.}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI. + II. + X.}{3}$	$\frac{VII. + II. + 2. IX.}{4}$
January .....	26.37	+0.22	-0.36	-0.18	-0.40
July .....	65.60	-0.06	-0.07	+0.94	+0.20

C. *From the Alps.*Geneva, lat. N.  $40^{\circ} 12'$ , long. E. Green.  $6^{\circ} 10'$ , height 1334 feet.

	Mean.	$\frac{S. R. + IV.}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI. + II. + X.}{3}$	$\frac{VII. + II. + 2. IX.}{4}$
January .....	30.81	-0.13	-0.54	-0.18	-0.16
July .....	64.16	+0.59	+0.43	0	-0.81

St. Bernard Hospital, lat. N.  $45^{\circ} 50'$ , long. E. Green.  $6^{\circ} 6'$ , height 8108 feet.

	Mean.	$\frac{S. R. + IV.}{2}$	$\frac{Max. + Min.}{2}$	$\frac{VI. + II. + X.}{3}$	$\frac{VII. + II. + 2. IX.}{4}$
January .....	13.41	+0.14	-0.31	+0.02	-0.02
July .....	42.84	+0.61	-0.18	0	-0.31

II. *Tables of Mean Temperature for the Month, Seasons, and the Year (207 Stations).*

Ten geographical groups are formed of the meteorological materials, and within these the stations are arranged alphabetically.

The number of stations is 207, and they are distributed as follows:—

1. Eastern India: 1, Assam; 2, Khássia Hills . . . . .	12
2. Bengál and Bahár, and Delta of the Ganges and Brahmapútra . . . . .	36
3. Hindostán, the upper Gangetic plain . . . . .	27
4. Pánjab, including the stations west of the Indus . . . . .	24
5. Western India: Rājvára, Guzrát, Kách, Sindh . . . . .	10
6. Central India: Berár, Oríssa, Málva, Bandelkhánd . . . . .	15
7. Southern India, hilly districts: 1, Dékhan and Maissúr; 2, Nílgiris . . . . .	29
8. Southern India, coasts: Kónkan, Málabar, Karnátik . . . . .	24
9. Ceylon . . . . .	10
10. Indo-Chinese Peninsula, Archipelago, and China . . . . .	20

The transcription of the geographical names is the same used and detailed by me in our 'Results'; the vowels are written as in Italian and German, the consonants as in English, with very few modifications, such as "th" being an aspirated "t," &c. Nasal modifications of the vowels are indicated by a circumflex. Every word has its principal accent marked by the usual sign. The sign  $\sim$  above a vowel shows its imperfect phonetic formation, such as "e" in *herd*.

\* The full detail is contained in vol. iii. pp. 139-60.

The *latitude* is north, unless an S is written before the respective numbers.

The *longitude*, east of Greenwich, is referred to the Madrás observatory, its value being adopted  $= 80^{\circ} 13' 56''$ . The sign \* before the stations indicates that the latitude and longitude have been determined by the great Trigonometrical Survey of India; our own determinations are marked by the sign †. For the remaining stations the coordinates are taken from the most detailed maps.

The *height* is given in English feet; I took it from our "Hypsometry," vol. ii. of the 'Results.' Heights in round numbers, for which I had no detailed data, are put in brackets. To places very little elevated above the level of the sea L.a.L.S. is added.

The *seasons* are formed as it is usually done also for the stations of other latitudes; these groups coincide besides, for Central and Northern India, with the character of the climate in general. For the stations in lower latitudes, however, the type of the climate only allows of distinguishing a hot season, a rainy one, and a cool one.

The *numerical values*\* are corrected only for instrumental errors, or combinations of hours not sufficiently careful; but the influence of height, and in consequence the difference from the isothermal lines next to the respective stations, had to follow separately.

\* The stations where no decimals are seen (but fractions or full numbers only) are stations of somewhat minor accuracy.

# 1. EASTERN INDIA.

## 1. ASSÁM.

Station.	Lat.	Long.	Height.	ft.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Búrpélah	26° 18'	91° 6'	396	62.2 (100)	71	75.7	78.5	80	82	83	82.5	88.5	71	65.2	64.5	75.1	81.7	80.7	75.5	75.5	
Dibrúgarh	27° 32'	94° 57.6'	62.2	63.4	71.3	72.7	77.1	80.7	83.7	81.8	81.4	81.6	75.6	67.4	61	62.2	73.7	82.1	74.7	73.2	
Gohátpur	26° 11'	90° 36.6'	63.2	67.8	73.7	78	80.4	81.8	83	82.9	79.2	71.1	65.5	64.9	65.3	77.3	80.9	76.7	75.7	75.8	
Gohátpur	26° 5.8'	91° 43.8'	63.6	67.6	74.5	77.4	81.5	84.5	85	83	79.2	66	60	60.3	75.8	83.7	82.6	77.5	77.5	75.8	
Golagáth	26° 33'	93° 58'	63.0	61.5	71.5	76.5	79.5	82	82.5	82	81.5	84.4	83.2	78.5	71.5	66.7	75.7	81.3	77.2	75.2	
Láthampur	27° 31'	94° 55'	410	61	62.5	68.5	73.5	79.5	82	82.5	82	84.4	83.2	78.6	69.8	63.5	63.7	76.5	83.9	77.2	75.3
Mángaldái	26° 24'	92° 1'	155	66.5	69	70	77	80	79.5	82.5	82	81.5	83.2	83.2	78.5	71.5	64.5	66.7	75.7	81.3	77.2
Naungóng	26° 21'	92° 49'	250	61.3	66.4	72	76.4	81.1	83.4	84	84.4	83.2	83.2	78.6	69.8	63.5	63.7	76.5	83.9	77.2	75.3
Nazirugháth	26° 52'	94° 42'	400	61.4	64.2	68	72	78.4	81.5	82.7	82	81.7	77.1	67.4	60.4	62	72.8	82.1	76.9	73	73
Sibásgar	27° 2'	94° 39'	370	60	64.1	69.3	73.8	78.05	82.4	83.6	83.5	83.1	78.3	69.4	62.4	62.2	73.7	83.2	76.9	74	74
Tezpur	26° 34.6'	92° 46.8'	278	59.7	63.8	69.5	74.5	78.9	82	82.7	81.2	81.3	77	68.5	61.6	61.6	74.3	82	75.6	73.4	73.4

## 2. KHÁSSLA HILLS.

Cherrapinjí	Lat.	Long.	Height.	ft.	51.8	54.7	61.5	63.5	67.2	67.1	68.5	68.1	67.8	65.8	58.8	55.1	53.9	64.1	67.9	64.1	62.5
					25	14.2	91	40.5	4125	51.8	54.7	61.5	63.5	67.2	67.1	68.5	68.1	67.8	65.8	58.8	55.1

## 2. BENGÁL AND BAHÁR,

### AND DELTA OF THE GANGES AND BRAHMÁPÚTRA.

Station.	Lat.	Long.	Height.	ft.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Bádúra	23° 14.8'	87° 31'	L. a. L. S.	63	72.7	79.7	85.5	87.9	87.2	84.2	84.3	81.9	74.4	70.5	63.2	66.3	84.4	85.2	75.6	78	78
Bárdwan	23° 13.2'	87° 48.9'	L. a. L. S.	66.6	73.7	81.2	86	90	84.8	81.8	81.9	85.3	82	73.9	65.1	69.9	85.7	86.1	80.1	80.4	
Barisál	22° 35.7'	90° 13.6'	L. a. L. S.	64.1	70	72.9	80.4	84.7	86.1	81.9	81.3	83.1	80.2	73.7	69.7	66.4	79.1	81.6	78.7	76.4*	
Barrakpur	22° 42.6'	88° 21.8'	L. a. L. S.	67.6	69.4	79.5	86.1	83.7	85.1	83.3	83.3	83.1	80.2	73.7	69.7	66.6	83.1	83.9	79	78.7	
Bhágalpur	23° 14.8'	86° 56.6'	154	62.6	73.4	78.6	89.9	92.1	87.9	85.7	82.5	84	77.5	69.5	63.1	66.4	86.9	85.4	77	78.9	
Birbhum	23° 54.4'	87° 30.6'	L. a. L. S.	67.2	72.9	81	86.6	89.3	86.6	84	83.7	83.8	80.2	78.3	71.1	64.3	65.5	69.5	84.6	79.2	79.8
Bígráh	24° 50'	89° 22'	L. a. L. S.	63.8	64.8	74	77.9	82.9	81.3	83.5	82.0	82.4	82.4	78.3	71.1	64.3	63.3	78.3	82.3	83	80.4
Calcutta	22° 33'	88° 20.6'	L. a. L. S.	65.60	71.06	77.99	82.37	85.37	84.18	82.69	83.05	83.06	81.35	74.68	67.70	68.12	68.12	82.24	83.31	79.70	78.34
Chaiabássó	22° 31.7'	85° 42.8'	L. a. L. S.	67	70.9	79.6	86	88.6	86.4	82.8	81.5	81.3	78	71.5	65	67.6	84.7	83.6	76.9	78.2	
Chandermagur	22° 50'	88° 23'	46	60.8	68.8	77.3	88.2	93.7	94.2	86.8	87.2	83.7	79.7	72.7	63.7	64.4	86.4	89.4	78.7	79.7	
Chápra	26° 45'	85° 25.8'	250	67	75.4	86.4	89.6	86.1	85.1	84.2	84.2	78.8	79.1	68.5	60	62.2	83.8	85.1	75.5	76.6	
Chittagóng	22° 20.5'	81° 44.1'	191	63.6	69.4	76	80.5	83	79.7	80.2	80.7	81.1	79.7	72.2	66.2	65.4	79.8	80.2	77.7	76.0	
Chunar	25° 7.5'	82° 51.6'	(300)	68	62.5	77.5	84	89	88	90	85.5	82.4	79.4	69.1	63.4	61.2	83.5	87.8	77.8	77.4	
Dánapúr	25° 26.6'	83° 36.8'	180	63	68.5	80	87	90	80.5	80.5	81.5	81.5	81.5	72	66	66	81.8	86	81.8	77.8	
Dámdám	22° 37.9'	88° 21.2'	L. a. L. S.	66.2	72.7	79	85.7	86	85.1	82.7	82.8	82.8	82.9	81.2	74.7	68.7	69.2	83.6	83.5	79.6	79
Dháka	23° 47'	90° 20.3'	72	65.6	69.9	70.2	78.9	81.9	78.5	82.2	82.4	82.1	82.1	74.1	67.6	67.6	82.7	83.3	79.8	78.4	
Fáridpúr	23° 36.5'	89° 48.9'	L. a. L. S.	65.8	74.5	70.2	80.4	81.8	82.9	79.2	71.1	65.5	65.6	77.4	73.8	67.2	67.7	82.2	82.7	78.7	77.1
Gáya	24° 49'	85° 0'	280	63.4	70.2	78.2	86.5	91.9	89.5	84.5	85.2	84.6	81.1	71.9	65.5	66.4	85.5	86.4	87.2	79.4	
Hazaríbágh	24° 0'	85° 20.9'	1750	60	65.2	73.5	80.5	84.9	80.6	77.5	76.0	76.0	76.0	72.9	66.8	62	62.4	79.6	79.6	73.4	
Hígli	22° 53.4'	88° 23.1'	L. a. L. S.	63.4	68	80	87	83.2	80.7	80.9	82.5	80	72.2	64.6	65.3	84	81.6	78.2	77.3	77.3	
Jessór	23° 9'	89° 71.1'	L. a. L. S.	62	71.2	78.6	84.4	84.8	83.5	83.7	83.6	83.85	85.2	75.1	64.5	65	82.6	83.5	81.4	78.4	

Kachar.....*	24 487	92 439	L. a. L. S.	62 95	66 65	73 45	76 8	80 95	82 2	82 4	82 9	77 1	82 5	77 9	75 6
Kishanpur.....*	23 28	85 20	(200)	60 15	72 15	78 8	85 75	88 65	82 3	78 15	78 95	78 7	76 5	75 3	76 2
Maimansingh.....*	24 44 8	90 20 9	L. a. L. S.	62 45	65 9	75 8	74 45	83 8	82 3	83 5	82 9	81 3	72 7	82 9	76 1
Midnapur.....*	22 24 3	87 17 9	L. a. L. S.	71	77 7	76 1	77 7	81 6	80 4	78 1	78 2	70 1	70 1	87 5	78 7
Monghyr.....*	25 27 4	86 40 2	200	65 1	68	84 1	92 1	86 5	84 6	86 1	85	82 5	74	68	78 7
Murshidabad.....*	24 11 8	88 9 9	L. a. L. S.	64	69 2	80 4	86	86 5	86 7	86 5	86 5	80 1	74	84 5	85 9
Noskelli.....*	22 45 5	90 57 8	L. a. L. S.	65 6	70 1	78 8	80 4	84 9	82 3	82 3	80 7	75	67 8	84 4	79 4
Pâma.....*	24 1	89 12	L. a. L. S.	65 2	72 8	78 9	83 9	85 3	83 7	85 3	84 1	84 2	79 5	71 8	68
Pâmea.....*	25 48	87 29 6	L. a. L. S.	63 1	64 1	70 1	70 1	87	83 1	84 1	87 1	83 1	79 8	71 1	64
Pâma.....*	25 37 2	85 7 5	17 0	60 8	66 1	76 1	83 9	88 3	87 3	84 5	84 7	83 9	80 4	71 1	62 2
Râmpur Boilea.....*	24 21 8	88 34 3	56	64 8	69 7	77 2	82 5	85 8	83 5	83 8	83 7	83 8	81 1	71 5	66 8
Râmpur.....*	25 42 8	89 11 4	72	61 5	67 5	75 1	81 8	82 3	81 3	83	83 4	80 3	74 8	69 2	66 1
Silhet.....*	24 53	91 47 1	L. a. L. S.	65 5	69 9	75	77 4	81 1	80 6	82 2	81 8	82	71	68 5	67 6
Tippera.....*	23 27 5	91 2 3	L. a. L. S.	64 7	68 4	75 6	81 1	82	81 5	81 6	81 3	80 2	72 2	72 2	77 8
Trinât.....*	26 7 3	85 22 8	255	64 9	73 7	82 3	86 8	80 7	80 3	84	79 2	69 6	61 4	81 6	76 3
														82 6	75 7

### 3. HINDOSTAN, THE UPPER GANGE PLAIN.

Station.	Lat.	Long.	Height	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Ágra.....*	27 10 2	70 1 7	65 7	57 5	66 4	76	85 5	94 8	93 9	86	85 3	84	78 1	69 2	60 2	61 4	85 4	88 4	77 1	78 1
Aligârh.....*	25 53 8	78 39	750	58 6	63 3	75	83 9	91 4	93 6	87 2	86 3	84 4	78 4	68 3	60 6	60 8	83 4	89	77 5	77 5
Alibabad.....*	25 26	81 51 9	316	64 2	67 6	77 3	92 6	91 9	90 0	86 3	85 7	83 7	71 6	64 9	65 6	69 2	89 1	80 1	81	81
Azimgâr.....*	26 32	83 9 9	(550)	60	70 6	78 2	85 6	88 5	90	84 8	84 2	80 2	69 6	61 7	64 1	84 1	86 7	78	78 2	78 2
Baréli.....*	28 22 2	79 23 2	693	58 9	65 8	71 6	77 8	86 8	89 7	84 3	86 5	81	78 4	71 2	60 2	61 6	78 7	86 8	76 9	76 9
Benâras.....*	25 18 4	82 59 8	347	62 1	69 2	79 4	88 9	95 3	91	84 9	85 7	84 9	81 4	71 6	64 3	65 2	87 9	87 2	79 3	79 9
Bijnâz.....*	29 22	78 9	530	53	64	74 1	81	87 1	92	86	87 1	86 4	76 8	65 9	57	58	81	88 5	76 4	76 0
Déli.....*	28 38 9	77 13 1	827	55	60 7	69 2	79 3	87	91 1	85 2	82 5	81 6	74 4	63	56 7	57 5	78 5	86 3	73	73 8
Étava.....*	26 45 5	78 59 9	550	58 4	64 8	74 4	82 4	89 9	92 5	85 3	84 4	84	77 8	66 5	57 6	60 3	82 2	87 4	76 1	76 5
Fatigâr.....*	27 23 3	79 37	635	57 9	65 8	74 1	82 4	91 2	90 7	86 2	83 7	83 4	76 9	67 8	64 9	65 3	86 6	87 8	80	80
Ghâzipur.....*	25 33 6	83 31 8	351	63 6	67 5	79	87	90 1	88 3	87 8	84 5	86	83 5	70 6	64 9	65 3	86 6	87 8	77 6	76 6
Jârânpur.....*	26 46 1	83 18 7	340	62 6	66 8	74 5	83 1	88 3	87 8	82 4	84 2	87 8	70 3	63 4	64 3	62	86 7	87 3	77 7	77 3
Kâlsi.....*	30 14	77 1 2	(1100)	58 3	61	62 6	77 7	81 1	86	83 7	80 2	77 2	70 8	63 2	59 7	59 6	73 8	83 3	70 3	71 8
Kâlnâpur.....*	26 28 3	80 20 3	525	58 3	66 4	75 7	86 3	93 8	93 4	85 2	85 9	84 8	78 1	69 8	61 7	62 1	85 3	88 2	77 6	78 3
Mainâpuri.....*	27 14	79 2	620	58	68	73	93	94	91	88	83	80	73	68	60	62	86 7	87 3	77 4	74 8
Mâthâ.....*	27 30 2	77 40 3	655	60 4	67 5	74 4	84 1	89 5	93 4	86 8	86 5	86	80 1	72	62 7	63 5	82 7	88 9	79 4	78 6
Mirâth.....*	29 0 7	77 41 6	56 9	56 9	62 9	70 7	80 5	88 7	91 9	85 7	85 3	84	76 6	58 7	59 5	80	87 6	87 6	76 1	75 8
Mîrzâpur.....*	25 9 3	82 33 9	362	61 1	64	75	83	90	90	87	86	85	80	70	64	63	83	88	78	78
Mozâfarpur.....*	26 7	83 21	(300)	56 8	64 6	73 6	77 1	86 9	86 4	84 4	83	82 6	78 1	67 5	60 1	60 8	80 7	84 7	76 1	75 6
Murâdâbâd.....*	28 49	78 56	673	58	60 9	72 6	80 6	86 7 5	88 7 5	84 1	84	83 5	74 9	66 1	58 7 5	58 9	80	85 6	74 7	74 8
Panipât.....*	29 23	76 59	936	56 1	74 4	80 4	86	91 6	88 6	86 3	86 3	83 1	77 4	67	60 7	68 4	79 1	88 4	75 8	75 4
Sahâranpur.....*	29 57 2	77 28 8	1002	55 5	58 9	70 5	85 3	91 8	88 3	82 3	83 3	77 9	70 7	58 3	56 6	54 8	74 3	84 7	69	70 4
Sarâul.....*	28 30	79 10	(700)	50 7	57 1	66 4	75 6	81	85 7	85 1	83 3	77 9	70 7	58 3	56 6	54 8	74 3	84 7	69	70 4
Shahjehânpur.....*	28 1 6	79 31 8	(1200)	56 1	59 5	67 5	78 3	86 3	91 9	85 7	86 5	82 4	77 3	67 6	61 8	59 1	77 4	88	75 8	75 1
Stâtpur.....*	27 35	80 44	(450)	60 7	68 3	76	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	85 9	85 9	85 9	85 9
Sultânpur.....*	26 15 6	82 33	(450)	60 7	68 3	76	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	87 1	85 9	85 9	85 9	85 9

4. PĀNJĀB,  
INCLUDING THE STATIONS WEST OF THE INDUS.

Station.	Lat.	Long.	Height. ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Ambala .....	30° 21' 4	76° 46' 8	1026	54.5	61	69.9	78.4	86.5	91.1	85.8	85.7	84.3	75	63.2	56.2	57.2	78.3	87.5	74.2	74.3
Asni .....	29 12	70 7	(410)	52	61	70.5	79	86	93	90	86.5	86.5	72.5	...	...	...	78.5	89.8	...	...
Bāmu .....	32 40	70 30	(1800)	49.5	55	64	74	82	93	91	88.5	86.3	75	64.8	55.1	53.2	73.8	90.8	75.4	73.2
Dera Ghazi Khan .....	30	70 54	(430)	51.4	59.7	68.9	78.6	85.2	93.8	91.3	88.3	86.2	71.7	64.5	55.5	55.5	77.6	91.1	74.1	74.6
Déra Ismāiel Khan .....	31 39' 6	70 56' 5	478	49	58.6	70	79	86.5	94.5	95.6	91.5	90	81.2	67	52.7	53.4	78.5	93.9	79.4	76.3
Firozpur .....	30 57' 1	74 38' 4	1120	51	58.5	66.9	77.1	83	91.1	88.2	86.4	85.4	73.4	62.2	53.7	54.4	75.7	88.6	73.7	73.1
Gorindgārḥ .....	31 40	74 45	(900)	51	56	64.7	73.2	81.2	85.3	85.5	84	83.5	76.5	63.2	55.5	54.2	73	84.9	74.4	71.6
Gugēra .....	30 51	73	(600)	50	59	69.5	71.5	88.1	95.4	96.9	89.5	82	79.8	72	65	57.5	58.3	85	88.3	72.3
Hānsi .....	29 6.1	75 57' 1	(1000)	55.5	62	71.5	88.1	95.4	96.9	95.5	86	82	79.8	72	65	56.5	56.5	77.4	87.7	75.2
Hoshiarpur .....	31 32' 2	75 53' 9	1066	53.9	59	66.6	80.5	85.2	92.1	86.2	84.7	84.1	78.4	63	56.5	56.5	77.4	87.7	75.2	74.2
Jallāndhar .....	31 19' 5	75 33' 3	(900)	53.5	59.6	66.9	76.4	81.5	87.4	86.9	84.4	83.9	75.9	65.6	57.9	57	74.9	86.2	75.1	73.3
Jhiliū .....	32 55' 2	73 42	(1620)	50.45	58	65.2	73.3	83.4	91.5	87.25	85.2	84.95	74.5	64.6	49.05	52.5	74	88	74.7	72.3
Kartarpur .....	31 26' 7	75 29' 1	(800)	57	61.4	67.5	76.6	86.4	91	87.5	87	88.6	79.6	69	59.5	76.8	88.5	87.9	79.1	76
Kohāt .....	33 32' 5	71 22' 9	1725	51.8	59.4	68.7	75.9	86.7	91.3	90	87.6	86.7	78	62.2	57.6	57.6	77.1	89.6	75.6	74.7
Lahor .....	31 31.1	74 14.6	839	52.3	60.7	68.3	78.6	87.1	92.2	87.6	86.4	85.7	77	66.4	57.7	56.9	78	88.7	76.4	75
Laya .....	30 59	70 57	(450)	49.5	59.3	66.6	76.5	83.2	91.9	88.6	85.9	83.8	71.6	58.8	50.5	53.1	75.4	88.8	71.4	72.2
Ludhiana .....	30 55' 4	75 50' 2	893	51.5	61.8	67.8	77.4	84.7	91	87.8	87.8	84.8	75.3	70.5	53.4	55.6	76.6	88.9	79.2	76.8
Multān .....	30 10' 2	71 34' 6	(840)	56.5	61	67	80	84.7	94	92	90	84.5	77.5	68.2	57.8	59	77.2	92	79.2	76.8
Nakódar .....	31 7	75 27	(840)	53.9	...	69.4	78.6	85.05	91.8	89	84.5	85.7	74	57.6	56	51.5	77.6	88.4	77.1	72.5
Naushera .....	34 3.1	71 53' 4	(1200)	51.1	51.1	61.4	74	81.9	95.2	91.2	89.7	85.9	74	57.6	56	51.5	72.4	92	72.5	71
Peshawar .....	34 3.2	71 33' 3	1280	52.3	57.1	62.5	73.2	81	90.1	91.8	87.6	86.1	73.7	63.2	55.9	55.1	72.2	89.8	74.3	72.9
Rāulpindi .....	33 36' 5	72 59' 8	1737	51.4	56.4	60.4	72.8	81.5	90.1	86.1	83.3	81	76	63.1	54.3	54	71.6	86.5	73.4	71.4
Shāhpur .....	32 14	72 32' 5	681	53	54	62	80	86	95	91	93	87	76	65	58	55	76	93	76	75
Vazrabād .....	32 26' 3	74 6' 4	(900)	52	61.9	67.8	77.8	86.1	93.3	89.1	88	87.3	77.7	66.1	57.3	57.1	77.2	90.1	77	75.4

5. WESTERN INDIA,  
RAJĀVARĀ, GUJARĀT, KĀCH, SINDH.

Station.	Lat.	Long.	Height. ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Ābu .....	24° 45'	72° 40' 6	3850	...	74	76.7	78	74	85.6	82.7	83.5	82.2	73	65.1	65.3	76.2	86.6	86.9	79.5	79.6
Ajmir .....	26 27' 2	73 14	(1500)	61.7	69.3	73.2	81.7	90.6	94.7	88.4	80.8	81.4	82.1	79.8	73.3	71.2	89	83.5	78.4	80.5
Barōda .....	22 16	73 14	L. a. L. S.	69.3	(2000)	64.7	75.1	88.2	94.5	91.7	85.8	82.6	82.6	75	68.9	...	...	85.9	86.7	74.7
Bērī .....	26 6	74 21	(281)	65.1	71.1	79.1	84	87	81	80	79	75	70	59	65.3	81.3	85.8	76	74.4	
Erīnpura .....	25 9' 3	73 63	(1500)	48.5	59	70.5	84.1	89.4	90.3	85	82.1	81.7	79.1	67.2	56	54.5	80	86	79	77.7
Kārachi .....	24 45' 5	67 0 9	L. a. L. S.	67	67	77	79	83	87	84	88	86	80	72	63	66	80	86.1	82.2	76.9
Nazrābād .....	26 4	74 20	(2000)	60.6	68.6	79	87.4	91.8	90.4	90.1	85.7	82.7	82.5	78.8	68.5	58.2	60	81.6	86.2	76.6
Nimāch .....	24 27' 5	74 59	1356	63.9	70.8	78.6	86.8	90.3	86.6	79.5	78.1	78.5	78.7	73.5	65.2	66.6	85.2	81.4	76.9	77.5

6. CENTRAL INDIA,  
BERĀR, ORĪSSA, MĀLVA, BĀNDELKHĀND.

Station.	Lat.	Long.	Height, ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.
Bāīl	21° 51' 2	77° 54' 8	645 (2000)	59.3	62.3	72.2	76.7	87.6	84.8	80.4	75.6	78.3	63.3	60.8	60.8	77.6	71.8	72.5	72.5	
Hāmīrpur	25° 58	80° 12	647	74.2	70.5	80.1	90	94.7	93.8	93.4	85.3	85.7	82.1	69	63.7	67.5	86	88.1	78.7	
Hushangābād	22° 45	77° 42	1050	62.8	66.8	75	85.3	91.3	87.8	81	80.8	80	70.7	60.8	63.5	88.3	85.3	85.3	77.2	
Jālpur	23° 9' 7	79° 56' 3	1396	74.5	70.5	78.9	88.4	93.7	92.6	84.1	82.4	82.2	80.7	73.4	67.9	63.5	83.9	83.1	74.8	
Jhānsi	25° 28	78° 35	1214	74.5	63.6	77.9	81	85.1	87.8	86.3	83.3	82.3	82	79	77.3	64.7	66.3	87	85.4	
Kokonāda	17° 6	75° 49	1862	74.5	71.4	74.9	84.3	93	96.3	86	81.1	81.5	81.6	75.4	72.6	72.9	91.2	82.7	79.5	
Mānu (Mhow)	22° 33	79° 7	9535	71.4	74.9	84.3	93	83.1	84.8	86.7	81.1	79.8	79.5	77.7	70.5	62	62.4	80.6	82.5	
Nāgpur	21° 10	79° 8	1305	60.8	64.4	74	76.4	82.7	91.3	92.4	85.7	84.1	83.7	80.2	71.1	63.4	65.9	83.5	87.4	
Nārsinghpur	22° 57	79° 8	570	60.9	73.3	80	90	96 $\frac{1}{2}$	95.2	90.2	87.2	86.2	82.5	68.8	66	68.8	88.8	90.9	78.8	
Nāngōng	25° 3' 5	79° 27' 6	1700	65	75 $\frac{1}{2}$	80.6	85	86.5	85.85	84.2	84.7	83.95	81.7	76.5	72.1	71.5	84	84.9	80.7	
Orāi	25° 59	79° 31	458	74.5	73.5	80.6	85	90	96 $\frac{1}{2}$	95.2	90.2	87.2	86.2	82.5	72.1	71.5	64.5	83.5	86.4	
Puri	19° 48' 2	85° 45' 8	1862	58	71 $\frac{1}{2}$	73	86	91 $\frac{1}{2}$	92	86	81 $\frac{1}{2}$	76 $\frac{1}{2}$	76 $\frac{1}{2}$	65 $\frac{1}{2}$	64.1	64.1	64.1	83.1	81.7	
Sāgar	23° 50' 2	78° 43' 4	1906	60 $\frac{1}{2}$	66 $\frac{1}{2}$	75	83.9	90.4	86.4	80.4	78 $\frac{1}{2}$	74.5	78	...	...	...	...	...	...	
Sehōr	23° 12	77° 1	1620	71.4	75.9	81.2	... 83.21	L. a. L. S.	L. a. L. S.	87.1	84.5	84.5	84.5	84.5	84.5	84.5	84.5	84.5	84.5	
Vizagapatam	17° 41	83° 21	1830	71.4	75.9	81.2	... 83.21	L. a. L. S.	L. a. L. S.	87.1	84.5	84.5	84.5	84.5	84.5	84.5	84.5	84.5	84.5	

## 7. SOUTHERN INDIA, HILLY DISTRICTS:

## 1. DÉKHAN AND MAISSŪR.

Station.	Lat.	Long.	Height, ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.O.N.	Year.	
Ahmadnāgār	19° 6	74° 46'	2133	72.1	78.2	79.7	80.6	75.3	73.2	74.4	74.5	74	73.5	72.8	71.5	69	70.2	79.5	74.3	78	
Bangālūr	12° 57' 6	77° 33' 5	2949	69.5	70	74	82	81.5	84	82	74	74.5	74	73.5	70.5	68	70.6	82.5	76.8	75.6	
Bēlegūl	15° 50	74° 32'	2500	73.8	84.8	87.5	86.4	83.3	80	80.1	78.4	78.4	78.8	77.3	73.5	75.1	86.2	81.1	78.2	80.2	
Bellārī	15° 8' 9	76° 53' 8	1538	78.7	75.3	84.8	88.4	88.5	85	81.2	78.7	78.7	78.2	76.6	76.7	77.7	87.2	81.6	77.2	81.7	
Bijāpur	16° 50	75° 47	1700	70.2	74.7	77.2	80.4	80.3	74.8	72.9	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	73.5	76.3	
Dhārvār	15° 27	75° 1	2423	72.8	77.6	81.4	83.5	83.9	79.2	75.4	74.3	76.9	77.1	75	73.7	74.7	82.9	76.3	76.3	77.6	
French Rocks	12° 31	76° 40	2620	1115	76.8	83.1	90.5	... 84.2	84.2	87.7	86.7	81.2	75.8	79.7	79.3	75	76	86.8	86.7	80.3	
Gūti	15° 6' 9	77° 38' 1	1900	74	78.9	86.1	87.7	86.7	81.2	87.7	86.7	81.2	79.7	79	80.7	79.3	75	76	86.8	86.7	77.8
Hārihār	14° 31	75° 51	1900	74.3	75.7	83.2	87	87.7	86.1	87.7	86.1	87.7	77	77	79.4	77	72.5	74.2	86.7	79.7	79.6
Jalna	19° 51	75° 54	1652	76.8	77.6	81.4	83.5	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	83.9	
Kādāpā	14° 28' 8	78° 48' 4	364	70.5	71.5	74.5	72.4	66.3	69.1	69.1	69.1	69.1	67.3	67.8	69.6	70	69.3	78.1	89.8	86.5	
Kārnūl	15° 49' 9	73° 50' 2	900	78.9	80.9	86.8	91.3	90.4	87	82.4	82.5	82.5	82.3	81.5	81.5	78.9	76.6	89.5	84.0	83.3	
Kirki	18° 33' 5	73° 50' 2	1850	71	75	81	81.5	82.5	78.5	77	75	75	75	77	77	71	72.3	81.7	76.8	77.3	
Mahabālēshvar	17° 54' 4	73° 38' 7	4200	64	66.3	71.5	74.5	72.4	66.3	63.2	63.2	63.2	63.2	64.4	64.4	64.4	64.5	72.8	64.2	66.6	
Mekāra	12° 24	75° 45	4606	69.4	72.4	76.8	75.9	74.2	69.1	67.3	67.3	67.3	67.3	67.8	69.6	70	69.3	70.4	75.6	67.8	
Phāltān	17° 59	74° 26	1700	74.8	76.9	83.9	86.1	81.2	80.2	79.3	78.9	80	73.5	72.9	74.9	84.6	80.2	77.5	79.3		
Pīna	18° 30' 4	73° 52' 1	1784	70.7	73.7	74.1	82	82.3	80.8	77.4	77.1	79.1	79.1	76.4	70.6	71.7	79.5	78.4	77.5	76.8	
Purandār	18° 16' 6	73° 57' 3	3974	67.3	70.2	77.6	80.1	77.6	69.6	65.2	64.7	64.7	64.7	67.6	68.2	67.6	78.4	66.5	66.9	69.8	
Sātāra	17° 41	74° 2	2220	70	72.6	77.8	80.6	80.1	77	73.8	73	73	74	76.1	76.1	76.1	71.5	79.5	74.6	74.1	
Sholāpur	17° 40	75° 58	1700	74.1	80	83	89	85	82	81	78	78	74	74	74	74	75.8	85.7	82.7	77.3	
Sikāndarābād	16° 26' 7	78° 27	1830	68.2	70.1	79.9	84.7	87.5	81.9	77.8	76.6	76.6	76.5	76.5	76.5	76.5	76.5	76.5	76.5	77.4	

## 2. NILGIRIS.

## 8. SOUTHERN INDIA, COASTS,

KÓNKAN, MÁLABAR, KARNÁTAK.

9. CEYLON.

Station.	Lat.	Long.	Height.	ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.C.N.	Year.
Bádula	59° 6'	8° 11'	2450	662	68½	71½	72½	71	69½	72	72½	71	70½	68½	70½	70·8	71·9	70·5	70·5		
Batikötő	36° 9'	2° 5'	L. a. I. S.	785	80·6	82·4	85·1	85·4	84·6	83·3	82·9	82·3	79·9	78·4	79·2	84·3	83·7	81·7	82·2		
Gále	59° 6'	10° 8'	L. a. I. S.	1739	70·6	72·5	74	74·6	73·8	72·5	73·3	72·7	72·2	71·8	72·1	71·6	74·1	73	72·3	72·8	
Kándi	17° 7'	49° 8'	L. a. I. S.	656·1	79·5	81·2	82·4	81·8	80·7	80·5	80·3	79·1	78·8	78·1	78·8	81·2	80·8	78·4	80·2	80·2	
Kolónbő	32° 6'	47° 18'	L. a. I. S.	1187	70·6	72·6	75·2	78·5	79·7	78·9	77·6	77·2	75·6	74·5	72	77·7	78·7	75·8	77	77	
Mátei	13° 8'	52° 52'	L. a. I. S.	6218	55·9	58	60·1	59·2	59·6	59·1	59	58·5	58	57	57	59·6	59·3	58·5	58·6	58·6	
Nurelia	13° 7'	2° 8'	L. a. I. S.	79	53·6	650	75·5	78·9	83	83·2	81·1	82·1	79·9	81·4	80·4	80·3	78·2	77·7	75·8	74·8	
Pátlam	17° 7'	49° 9'	L. a. I. S.	73·4	74·9	76·5	78	77·7	75·7	76·1	75·5	75·9	74·4	74	73·1	73·8	77·4	75·8	75·4		
Perecénia	35° 8'	13·2	L. a. I. S.	213	77·8	81·3	83·9	84	81·5	84·4	83·1	82·3	80·8	78·4	78·3	83·1	83	81	81·4		
Trinkonomáh	35° 8'	13·2	L. a. I. S.	77·8	81·3	83·9	84	81·5	84·4	83·1	82·3	80·8	78·4	78·3	83·1	83	81	81·4	81·4		

## 10. INDO-CHINESE PENINSULA, ARCHIPELAGO, AND CHINA.

Station.	Lat.	Long.	Height. ft.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	D.J.F.	M.A.M.	J.J.A.	S.C.N.	Year.
Akyab .....	20° 8'	92° 52' 6"	L.a.L.S.	70.8	73.4	73.8	83.5	85.6	81	81.8	81.7	81.4	80.6	82.7	72.8	72.2	72.3	82.6	81.3	79.1
Alor Gajah .....	2 11	102 17	L.a.L.S.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	81.8	...
Ára.....	21 50	96 2	L.a.L.S.	64.7	73.5	75.9	86.2	84	85.5	82.8	82.5	82.7	80.6	74.2	68.3	68.8	82	83.6	79.2	78.4
Bangkok .....	14	101 30	L.a.L.S.	76.7	79	83.8	84.2	83.7	82.8	82	81.7	81.3	80.8	80.5	76.9	76.5	83.9	82.2	80.9	81.14
Batavia .....	6 10	106 58	L.a.L.S.	79	79.3	80.4	80.1	80.6	79.2	78.9	79	78.7	78.3	77.6	79.4	79.2	80.4	78.7	77.9	79
Chusan .....	30 25	121 44	L.a.L.S.	40 1/2	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	38 3/4	43 1/2	40 9	43 1/2	40 9	43 1/2	67.8
Hong-Kong .....	22 11	114 7	(140)	68	63.2	65.5	73.8	80.7	84.4	86	83.1	83.5	78.5	71.9	65.4	65.5	73.3	84.5	78	75.3
Krakatoa-phyu .....	23 8	113 19	L.a.L.S.	52.5	55	62.5	70	77	81	83	82	73.3	65.2	57.1	54.8	69.8	82	72.8	69.9	69.9
Makao .....	22 11	113 32	L.a.L.S.	74.15	73.3	80.7	87.35	87.4	80.75	79.7	77.6	80.7	83.3	74.05	73.8	85.1	79.3	80.6	79.7	79.7
Manilla .....	14 36	121 9	L.a.L.S.	62	54.9	64.3	71.3	78.4	82.7	82.9	83.1	81.6	76.1	61.2	59.4	71.3	82.9	80.6	72.2	
Métrgui .....	12 27	98 35	L.a.L.S.	79.5	77.5	79.5	81.5	81.7	81.3	80.2	78.9	78.8	79.9	79.7	78.3	77.6	80.9	80.1	79.5	79.5
Padang .....	0 59	100 31	L.a.L.S.	81.7	81.3	80.6	82.8	80	78.6	78.4	78.6	77.5	79.5	80.8	81.3	81.3	81.3	81.3	81.3	
Rangun .....	16 48	96 17	L.a.L.S.	73.2	79.3	86.5	87	80.2	79.7	80.2	78	80.3	82.3	81.1	76.7	76.4	84.6	79.3	81.2	80.4
Samarang .....	8	110 31	L.a.L.S.	80.1	80.8	80.5	82.6	82.5	81.1	80.5	82.1	83.1	84.2	83.6	81.3	80.7	81.9	81.2	83.6	81.9
Saravak .....	1 34	110 29	L.a.L.S.	...	...	...	...	...	...	79.6	78.8	78.7	...	...	...	...	...	...	...	...
Sàndoye .....	18 25	94 30	L.a.L.S.	69.1	71.4	75.9	81.9	82.3	80.2	77.7	79	79.6	80.7	76.3	71.7	70.7	80	79	78.9	77.1
Shanghai .....	31 12	121 20	L.a.L.S.	40.2	39.5	46.7	56.9	65.7	69	81.9	81.6	74.4	67.3	55.8	45.1	41.6	56.4	77.5	65.8	60.3
Singapur .....	1 18	103 53	L.a.L.S.	78.7	80.1	80.5	81.1	81.8	82	81.3	81	80.2	79.3	79.4	81.1	81.7	81.1	80.7	80.7	79.5
Tawau .....	14 7	98 18	L.a.L.S.	76.5	79.5	81	82.6	81.6	79.2	78.6	77.8	79.6	80.6	78.1	78.1	78	78.8	78.1	78.8	79.3
Áden .....	12 46	45 15	187	72.5	73.4	76.8	80.6	84.9	85.5	83.3	81.5	84.9	83.3	78.6	77.2	74.4	80.8	83.4	82.3	80.2

### III. *Decrease of Temperature with Height in the Tropics.*

The decrease of temperature with height had to be taken into consideration, not only on account of its practical importance for the selection of stations and sanitaria, but also for comparing the different parts of India, independently of the accidental height of the observer's residency, and for drawing finally the general isothermal lines.

For the Dékhan and Central India, Púna, Purandár, and French Rocks could be compared with the coasts of the Kónkan and the Karnátik; for the South I had three stations in the Nílgiris and one in Ceylon, which could be referred to the shores of the Indian Ocean.

The following Table shows the results I had obtained for the year and the seasons:—

#### A. Dékhan and Central India.

Places of observation.	Height above the level of the sea.	Height in feet=decrease of 1° F.				
		Year.	Dec. to Feb.	March to May.	June to Aug.	Sept. to Nov.
Púna .....	1784	410	370	360	310	595
Purandár .....	3974	435	450	660	230	390
French Rocks .....	2620	750	900	1200	340	600

#### B. Nílgiris and Ceylon.

Places of observation.	Height above the level of the sea.	Height in feet=decrease of 1° F.				
		Year.	Dec. to Feb.	March to May.	June to Aug.	Sept. to Nov.
NÍLGIRIS.						
Átare Málé .....	4500	270	310	260	220	290
Utakamánd .....	7490	280	300	270	260	290
Dodabéttá .....	8640	310	350	310	265	300
CEYLON.						
Nurélia .....	6218	280	290	280	270	290

For the Dékhan and Central India we see that the decrease is very slow; for the Alps, for instance, I formerly obtained 320 English feet for 1° Fahr.\* As the principal cause of the decrease being not more rapid, we may consider, I think, the circumstance that the elevation, though not very considerable, extends itself with great uniformity over a large surface.

In the second group the values are less different from those in the Alps and in High Asia; for both groups of the Indian stations it is characteristic that the rainy season shows by far the most rapid decrease.

For showing *simultaneously* the variations of the decrease with the locality and the seasons, I have drawn three topographical profiles (see Plates XXIX.—XXXII.), and have indicated for each of the single seasons the difference of the respective decrease

\* Neue Unters. phys. Geogr. d. Alpen, p. 584. The numbers I have given there are 540 French feet for 1° C.

from its annual mean value by drawing a dotted line in connexion with the topographical outline. The dotted line shows the contour which the topographical section ought to have for the actual temperature of the season, supposing the value of the decrease would have remained the same throughout the year; if, therefore, the decrease in the season is too slow, the new ideal position of the station will be below the real topographical outline, on account of the station having a temperature as if it were in a less elevated situation; if, *vice versâ*, the decrease is more rapid than the annual mean, as we see it particularly to be the case in the rainy season, the dotted line will show, from the same reason, a profile which is higher than the topographical contour. For Ceylon I further added the point of its highest peak, Péduru talla gâlle, 8305 feet, for the sake of completing the general topographical profile of the island, though I had no higher station for its mountainous regions than Nurélia. The decrease of temperature with height in the Himálaya, the Karakorúm and Kuënlün had not to be calculated in connexion with the construction of these maps. As I had direct data for the beginning of the isothermal lines along the western and the eastern margin of these mountainous regions, the form of the dotted lines which I now have drawn across them could be obtained directly by uniting the terminal points. This circumstance is very valuable, too, when I come later to examine the influence which is exercised by the topographical formation (including vast plateaux, ridges, and isolated lofty peaks), and by the extent of the snowy regions, upon the alterations of the decrease of temperature with height.

#### IV. *Thermal Types of the Year and the Seasons.*

The considerations about the distribution of temperature over the *surface* of India in general may best be combined with the analysis of the isothermal curves on the maps annexed (Plates XXVIII.-XXXII.).

In reference to the geographical details, I have limited myself to the principal river-systems; and to avoid interfering with the distinctness of the isothermal lines, the names of the stations, as well as the mountain-systems, are left out; for the means of the year, the Indian Archipelago and countries to the north-east of it are also added on a smaller scale.

In drawing the lines, I made these distinctions: besides the lines being dotted where they pass the regions of High Asia, also the thermal equator is distinguished, its line being a broken one. In consequence of the great difference in latitude between the western and the eastern end of the Himalaya, the curves extend along the western margin of the Map from  $5^{\circ}$  to  $35^{\circ}$  of latitude; along its eastern margin only from  $5^{\circ}$  to  $30^{\circ}$ . For the period corresponding to our summer, the isothermal lines could be continued for Central Asia somewhat further to the north, in connexion with our personal stay in these regions.

The eastern part in the higher latitudes of the Map is throughout cooler than the western part, as shown in the following Table, where the numerical values are nearly the same, though the difference in latitude amounts to  $5^{\circ}$ .

	Warmest isothermal line.	Minimum in the N.W.	Minimum in the N.E.
Year .....	84	73	73
December, January, February .....	80	57	60
March, April, May .....	90	72	73
June, July, August .....	92	89	81
September, October, November .....	82	75	74

*The isothermal lines of the year* very decidedly show the influence of the topographical form of the Indian peninsula on the increase of the mean temperature: in the southern parts they follow the contours of the shores, or obtain forms evidently in connexion with them; in the northern part these lines are raised to the extent of a difference of five degrees of latitude where they pass over the central axis of India. At the same time, southern India presents one of those insular regions of greatest heat which are connected with each other by the thermal equator; the Indian archipelago shows us the next of these regions which follows to the east.

When comparing the seasons, we are particularly surprised by the unusually great variety of the four types, whilst in many of the more western regions of the tropics we see that it is more the numerical value of the lines which is changed than the type of their forms. In India and the Indian archipelago the thermal equator runs still to the south of the geographical one for all the three months of the cool season; but in the season corresponding to our summer, from July to August, we see it has been raised up to the latitude of 32° N. This part of the year is, for the greater part of the map, the rainy season, though for the region in the north-west it is the very season of an absolute maximum of heat. These variations have the more importance, as the territory here represented has a surface considerably larger than might be expected, perhaps, from the extent of European empires. The distance from the Bay of Biscay to the Caspian Sea can be considered as about equal to the difference in longitude of the borders of this Map; whilst 30° of latitude, referred to European regions, might be compared with the distance from the southern shores of the Mediterranean to St. Petersburg.

*The cool season.*—This period already shows traces of the increase of temperature in the interior of the land when compared to surrounding seas; but, as it must be expected, the influence of insolation is, comparatively speaking, but little felt during this season in the provinces at some distance to the north of the equator, on account of the southern position of the sun. In the regions beyond the tropics the hibernal influence of continents, compared to that of the seas, causes depression of temperature. In reference to the Pānjáb, it must be further added that we have here, comparatively speaking, a greater number of stations for which the actual temperature is still lower than the values represented by the isothermal lines, as the latter had to be reduced to the level of the sea. The general elevation of the ground, and, throughout the season, a sky unusually clear, so favourable to nocturnal radiation, may be mentioned as the prin-

cipal causes. The decrease of temperature with latitude is by far the most rapid in the cool season.

*The second period of the year* (March, April, and May), which is generally called the hot season all over India, also in its north-western parts, shows a remarkable difference in the type of the curves when compared to the cool season; the influence of the topographical forms of the peninsula has become now considerably more apparent. The thermal equator enters the western border of the Map already at an elevation of  $24^{\circ}$  of latitude, passes through a central region of maximum temperature exceeding  $90^{\circ}$ , and descends from thence directly to the south, to the very southern end of India. Great dryness is combined in this period with the high temperature, and is an important element for making its difference from the other seasons still more apparent; but it would be erroneous to expect, as it might appear rather probable, that in consequence the heat is felt the heavier by the human organism. Though the central parts, compared to the shores of the sea, show a rapid increase of temperature with the progress towards the interior, I must add that, on account of the moisture being greater along the shores, not only the heat is felt there more close and more oppressive, but also its influence on the health, particularly of the Europeans, is decidedly still more unfavourable. For the coasts, and for the interior of India up to latitude  $25^{\circ}$  N., these months remain the period of the year which includes the highest means, and also the greatest heat of single days.

*The third period* (June, July, and August) is, for the greatest part of India, the rainy season; its setting in is connected, particularly in Central India, with the most rapid sinking of temperature. Nearer to the shores the difference is felt less beneficial; the humidity has increased, too, and makes, in the shade at least, the heat the more oppressive. The power of the insolation now being broken by a sky nearly permanently clouded, must be named as the particular cause why the beginning of this season in general is considered as a welcome period. For the state of health, however, it is less favourable; dyspeptic complaints and fevers are particularly frequent in the latter part of this season. In the Pānjáb, and partly already in the north-west provinces of Hindostan, this period has no more the character of a rainy season. The precipitation takes the form of our summer rains with thunder-storms, and also the amount of precipitation most rapidly decreases towards the north-west.

At the same time the meteorological observations showed for these very regions a maximum of temperature which was unexpected to me, not only on account of the number of stations formerly existing being not very great, but also since I heard from the inhabitants, the Europeans as well as the natives, no unusual complaints about the heat being much greater than in other parts of India. Nevertheless these provinces include a region for which the mean temperatures during the three months exceed  $92^{\circ}$ , which therefore must be considered as one of the very hottest regions of our globe; besides, we must take further into consideration that clear days are not unfrequent, during which the purity of the sky is not even limited, as it was in the period pre-

ceding, by dust suspended in the atmosphere. Therefore also the absolute maxima in the shade as well as in the sun are higher here than in any other region of India.

I may further draw attention to the fact that for this region also the non-periodic variations of temperature, the variations between different years, have become much greater than we find them to be in the more southern tropical part of the territory examined. The thermal equator enters the west of the Map at the latitude of  $32^{\circ}$ , and only leaves the Indian peninsula near Ceylon in an easterly direction.

The influence of height in the Pānjáb is not very considerable in this season, and the curves I have drawn remain for some stations even still a little below the respective means; but in the other regions, where the character of the "rainy season" prevails, the decrease of temperature with height is more rapid than during any other part of the year.

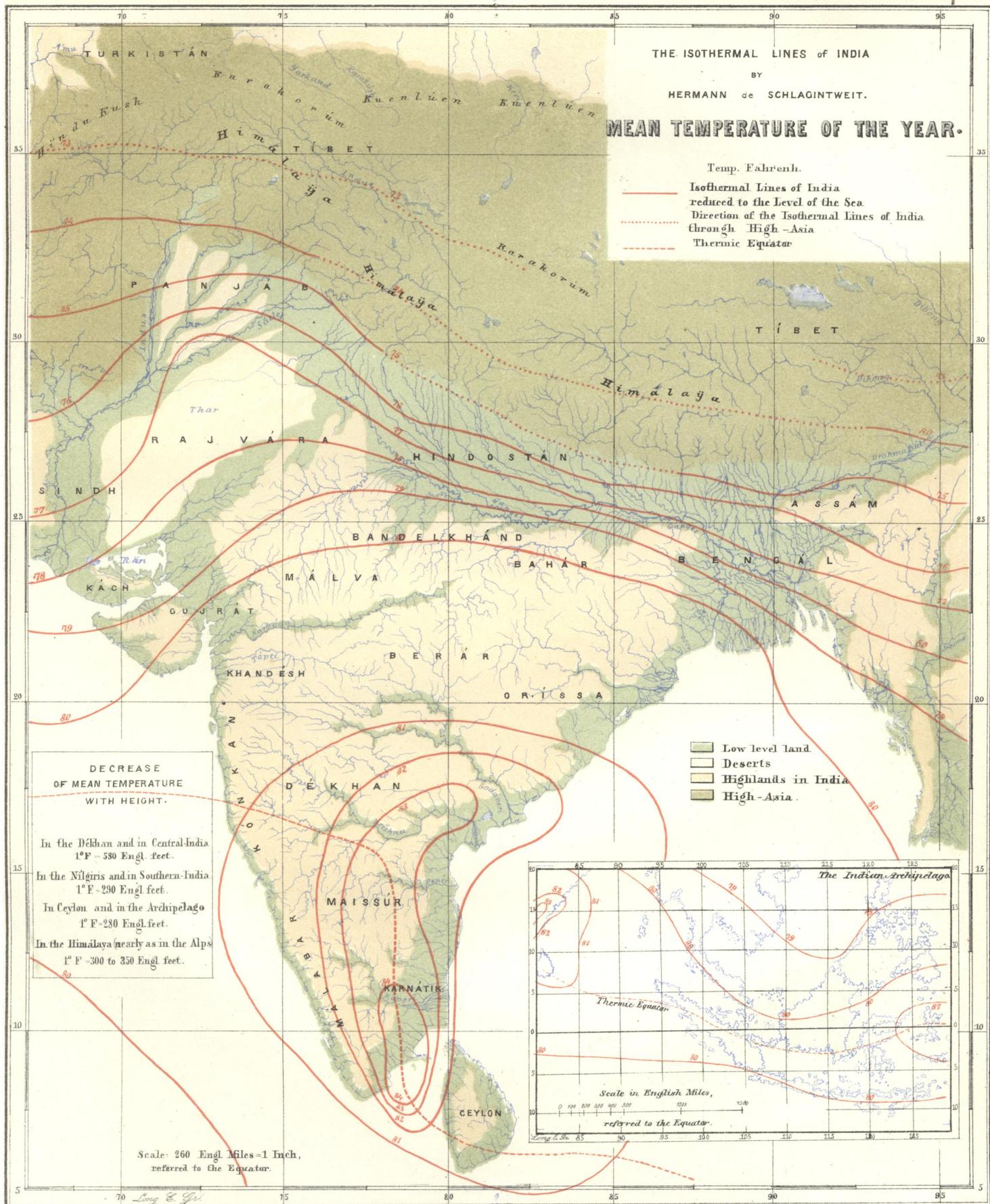
*Autumn* (September, October, November) is the only one of the tropical seasons which shows here a very regular form of its curves, and a very slow decrease of temperature with latitude; it is not less characteristic for this season that in most regions, particularly in those along the banks of the larger rivers, the drying up of vast surfaces formerly inundated is the cause of most deleterious miasmatic vapours; but in the Pānjáb, and in the hilly regions along the Brahmapútra and in Central India, where these dangerous modifications of the atmosphere are not to be feared, this season frequently approaches the mild and refreshing character of the regions of southern Europe.

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A more descriptive detail, together with the personal data in reference to the observers' names and the duration of the different series, will be given by me, later, in the 4th volume of our 'Results'\*. In the present memoir I considered it my particular object to lay down the materials officially entrusted to me, and to give them at the same time as critically worked over as my travels allowed me to attempt.

The temperature in shade, however, can but insufficiently define the climate as it is particularly seen in these parts of the tropics, where the power of solar radiation, rains, and storms differ in no less proportions from those in temperate zones. I will consider it a particular pleasure to be able to forward, in not too distant a time also for these elements, my numerical data, together with some remarks about the principal general results.

\* It also will contain some additional stations from the materials I obtained, with their usual liberality, from the Indian authorities during my recent visit to England. Amongst the official publications, those of GLAISHER and MACPHERSON have particularly to be quoted. These materials could no more be added to the present Tables, as most of these too will have to be recalculated for being reduced to true daily means.



## THE ISOTHERMAL LINES of INDIA

BY

## THE SEASONS. 1. THE COOL SEASON:

DECEMBER, JANUARY, FEBRUARY.

Rapid decrease with increasing latitude.

THE ISOTHERMAL LINES of INDIA  
BY  
HERMANN de SCHLAGINTWEIT.

THE SEASONS. 1. THE COOL SEASON:  
DECEMBER, JANUARY, FEBRUARY.  
Rapid decrease with increasing latitude.

Scale: 260 Engl. Miles - 1. Inch.  
referred to the Equator

(In this season the thermic equator does not yet rise into the northern hemisphere.)

The Decrease of Temperature  
with Height  
is in general less rapid in the  
cool season than in the  
mean of the year.

TOPOGRAPHICAL PROFILES  
in their relation to the  
DECREASE OF TEMPERATURE.

Dékhān  
and Central India.

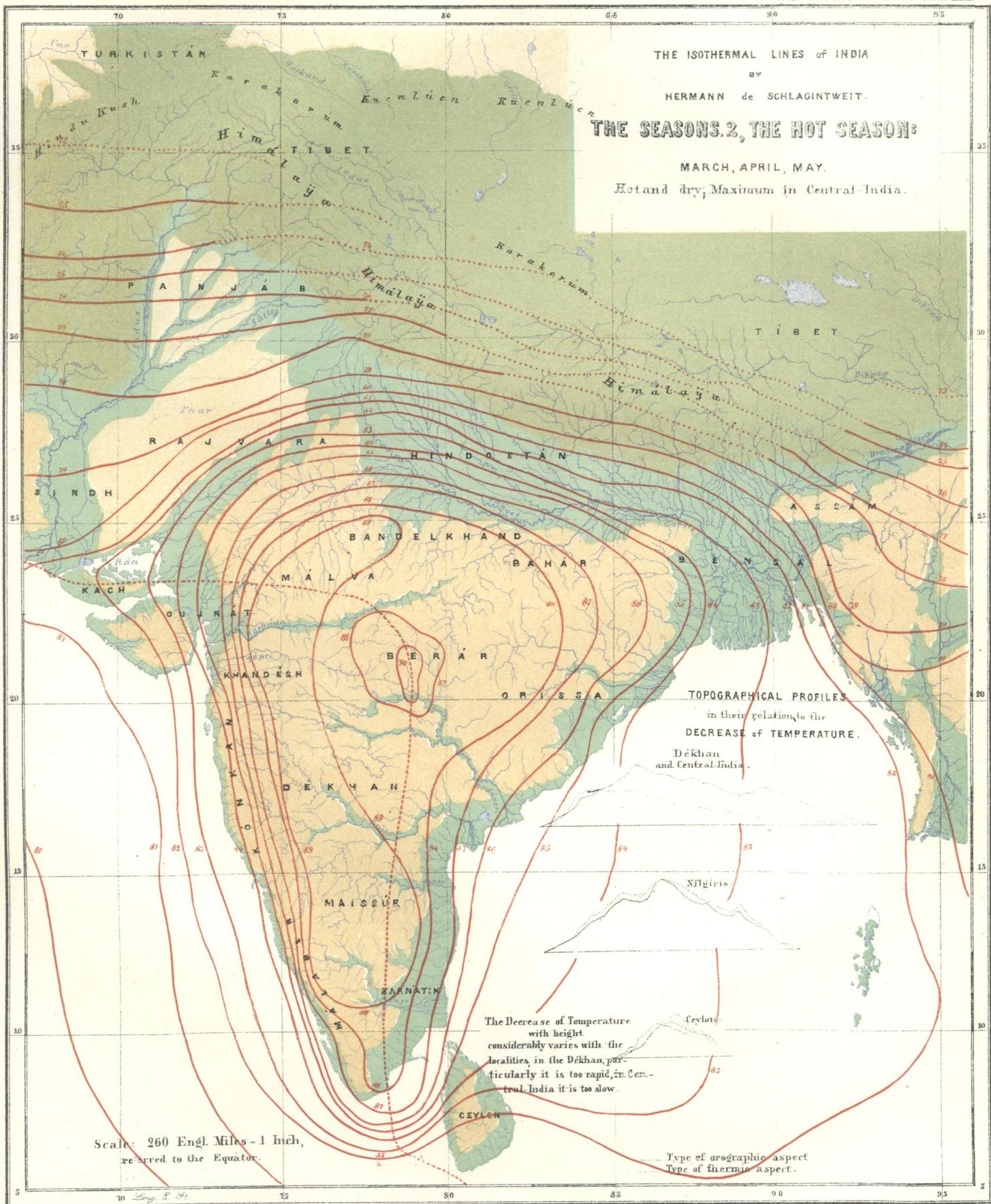
Nilgiris.

Ceylon.

Type of geographic aspect.  
Type of thermic aspect.

Scale: 260 Engl. Miles - 1 Inch  
referred to the Equator

Engraved and printed by F. Wolf, Munich.



## THE ISOTHERMAL LINES of INDIA

BY  
HERMANN DE SCHLAGINTWEIT.

## THE SEASONS.3, THE RAINY SEASON:

JUNE, JULY, AUGUST

Hot and moist; Absolute Maximum in the Panjab.

